Exploring the Natural Limits of the Northern Guam Lens Aquifer: A Step Toward Optimum Sustainable Management Phase 2-Implementation of a Numerical Model

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The Northern Guam Lens Aquifer (NGLA) provides 80% of Guam's drinking water. The anticipated addition of US Marine Corps activities will require additional production, while ongoing economic growth will increase demand as well. Policy-makers and water managers have begun asking "what is the absolute *maximum* volume of water that could be sustainably withdrawn from the aquifer?" Answering such a question requires identifying (1) the *natural limits* on aquifer recharge, storage, and water quality imposed by climatic and geologic conditions, (2) , but doing it *for an ideal production system*, i.e., one that is constructed and operated so as to achieve the maximum possible production for a given standard of quality. This study is therefore directed at estimating the *maximum potential capacity* of the NGLA, i.e., the capacity that ultimately *could* be achieved by an ideal production system, given what we currently know or must assume about the natural limiting conditions.

The principal investigators will lead a research team composed of themselves, a WERI research associate trained in modeling, and WERI-based graduate and undergraduate research assistants (UOG environmental science MS candidate), working in collaboration with colleagues at the USGS Pacific Islands Water Science Center (PIWSC) to assemble and prepare the data sets; identify climatic phenomena and geologic features that are most likely to exert significant control on rainfall amount and intensity, infiltration rates, aquifer storage, groundwater flow, and groundwater salinity on northern Guam; and apply statistical, geospatial, and other analytical tools to identify, characterize, and interpret past and present spatial patterns in rainfall, groundwater levels, specific conductivity, chloride concentrations, and production rates from existing wells within the NGLA. The team will develop scenarios to identify ideal configurations (i.e., configurations not limited by economic, social, legal, or other non-natural factors) of well distribution and spacing, depth, and pumping rates that could thus in principle maximize production from the aquifer for specified limits on saltwater content. Scenarios will also examine how the ideal configuration might also respond to different long term climatic conditions.

The objectives of the respective phases of this project are: 1) Data acquisition and literature review of published and emerging research on spatial and temporal distributions and trends of rainfall and salinity in the NGLA by WERI, USGS and others; 2) Study of meteorological and geological phenomena that might control or influence the observed rates and amounts of rainfall, infiltration, storage, flow, and salinity; 3) Analyses of spatial and time-series data on rainfall, groundwater levels, specific conductivity, chloride concentrations, and production rates from existing wells within the NGLA; 4) Application of a groundwater model to estimate the maximum production that could be attained from an optimum set of strategically spaced shallow-draft vertical wells producing at specified maximum acceptable values of salinity, under specified natural conditions (*e.g.*, long-term average rainfall, vs. historic wet and drought conditions); and 5) Development of a production function that estimates the relationships between quantity and quality that might be produced by an ideal production system (i.e., one that would produce maximum quantity for a given quality or maximum quality for a given quantity.

Dr. Mark Lander with installed rain gauge in northern Guam.